LIFE SCIENCE STANDARDS: NGSS VS. STATE(SD)

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WHY NEXT GENERATION SCIENCE STANDARDS?

- **National science documents used by states to develop standards are more than 10 years old**
  - National Research Council's *National Science Education Standards* were published in 1996
  - American Association for the Advancement of Science's *Benchmarks for Science Literacy* were published in 1993
- **Call for new, internationally-benchmarked standards**
  - Students in the U.S. have consistently been outperformed on international assessments such as TIMSS and PISA
  - States across the country will soon engage in a science revision
    - 20 States have not revised science standards in at least 5 years

INTERNATIONAL STUDY: QUANTITATIVE ANALYSIS FINDINGS

Overall findings: Upper Secondary Levels

- **Physics** - on average, emphasis is on Newtonian mechanics, science, technology & society and electricity; atomic structure receives significant emphasis in both physics and chemistry
- **Chemistry** - organic chemistry and stoichiometry on average receive unexpected attention
- **Biology** - on average the categories receiving the most emphasis are Cells-structure and function; Reproduction, development & heredity; Systems, organs and tissues)
- **Earth and space science** - only 3/10 countries have E/ss courses at upper secondary; these courses included the most interdisciplinary and cross-cutting content –on average 40%

CONCEPTUAL FRAMEWORK DRAFT

Contains three dimensions:

- **Dimension I** – Scientific and Engineering Practices
- **Dimension II** – Cross Cutting Concepts
- **Dimension III** – Disciplinary Core Ideas

Dimension I – Scientific and Engineering Practices

- The Framework identifies eight science and engineering practices:
  1. Asking questions and defining problems
  2. Developing and using models
  3. Planning and carrying out investigations
  4. Analyzing and interpreting data
  5. Using mathematics, information and computer technology, and computational thinking
  6. Constructing explanations and designing solutions
  7. Engaging in Argument from evidence
  8. Obtaining, evaluating, and communicating information

DIMENSION II: CROSS-CUTTING CONCEPTS

1. Patterns, similarity, and diversity
2. Cause and effect: mechanism and prediction
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter: flows, cycles and conservation
6. Form and function
7. Stability and change

DIMENSION III: DISCIPLINARY CORE IDEAS

Physical Sciences

- PS1: Matter and its interactions
- PS2: Motion and stability: Forces and interactions
- PS3: Energy
- PS4: Waves and their applications in technologies for information transfer

Life Sciences

- LS1: From molecules to organisms: Structures and processes
- LS2: Ecosystems: Interactions, energy, and dynamics
- LS3: Heredity: Inheritance and variation of traits
- LS4: Biological evolution: Unity and diversity

Earth and Space Sciences

- ESS1: Earth's place in the universe
- ESS2: Earth's systems
- ESS3: Earth and human activity

Engineering, Technology, and Applications of Science

- ETS1: Engineering design
- ETS2: Links Among Engineering, Technology, Science, and Society

Core Idea LS1: From Molecules to Organisms: Structures and Processes

- LS1.A: Structure and Function
- LS1.B: Growth and Development of Organisms
- LS1.C: Organization for Matter and Energy Flow in Organisms
- LS1.D: Information Processing

Core Idea LS2: Ecosystems: Interactions, Energy, and Dynamics

- LS2.A: Interdependent Relationships in Ecosystems
- LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
- LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- LS2.D: Social Interactions and Group Behavior

Core Idea LS3: Heredity: Inheritance and Variation of Traits

- LS3.A: Inheritance of Traits
- LS3.B: Variation of Traits

Core Idea LS4: Biological Evolution: Unity and Diversity

- LS4.A: Evidence of Common Ancestry and Diversity
- LS4.B: Natural Selection
- LS4.C: Adaptation
- LS4.D: Biodiversity and Humans

SD HIGH SCHOOL LIFE SCIENCE STANDARDS (2005)

9-12.L.1.1. Students are able to relate cellular functions and processes to specialized structures within cells.
9-12.L.1.2. Students are able to classify organisms using characteristics and evolutionary relationship of major taxa.
9-12.L.1.3. Students are able to identify structures and function relationships within major taxa.

9-12.L.2.1. Students are able to predict inheritance patterns using a single allele.
9-12.L.2.2. Students are able to describe how genetic recombination, mutations, and natural selection lead to adaptations, evolution, extinction, or the emergence of new species.

9-12.L.3.1. Students are able to identify factors that can cause changes in stability of populations, communities, and ecosystems.

SUMMARY: SD STANDARDS VS NGSS

- **Current SD standards**
  - Better coverage on biodiversity (classification and diversity)
  - The word "biodiversity" is correctly used
  - Concepts on evolution is minimal and NOT emphasized
  - Cross cutting concepts existed but unstressed
  - More content, less scientific/engineering practices
- **NGSS (draft)**
  - Stronger emphasis on evolution, energy flow…….better!
  - As is, the word "biodiversity" is misused, no coverage on biodiversity…… poor!
  - Emphasis on cross cutting concepts .....good!
  - Less content, more practices, engineering practices introduced…..good!
  - Knowledge on human environment interaction is stressed to be broadened….good!
  - Performance expectation higher